EXECUTIVE SUMMARY REPORT OF INTERNATIONAL ASSIGNMENT

DATE: 1 March 1994.

1. **Consultant Name:** James A. Doolittle
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160 East 7th Street
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2. **Country(s) Visited:** Jamaica

3. **Dates and Duration:** 10 - 19 January 1994

4. **Host Country Cooperating Institutions:**
ALCAN Jamaica Company
Agricultural Division
P.O. Box 52
Mandeville, Jamaica, West Indies

5. **U.S. Cooperating Institutions:**
Texas A & M University
Soil and Crop Sciences Department
College Station, Texas 77843-2474

Soil Management Collaborative Research Support Program
Management Entity Office
Box 7113
North Carolina State University
Raleigh, North Carolina 27695-7113

6. **Objective or Purpose of Visit:**
The purpose of this investigations was to use geophysical techniques to evaluate soil microvariability of mined-out and reclaimed bauxite lands. These and other studies will assist maintaining and improving existing levels of productivity. The study provided a unique opportunity to evaluate the capabilities of ground-penetrating radar (GPR) and electromagnetic induction techniques in areas of highly weathered tropical soils.

7. **Summary of Activities:**
I arrived in Mandeville on 10 January 1994. My geophysical equipment arrived in Kingston, Jamaica, on 5 January 1994, but did not clear customs until 14 January. When the equipment was delivered to me, it was obvious that customs had opened all my packages and were negligent in repacking the sensitive electronic equipment. Items were not properly repacked and lids to the transport cases were not properly sealed. Fortunately, no major damage to the equipment was incurred. It appeared that the custom agents wanted me to know that the equipment had been "thoroughly" inspected. I

have never experienced such a blatant disregard by custom officials for the care of my equipment.

The Agricultural Division of ALCAN Jamaica Company has assumed the leadership for the project. The title of this project is "Land quality and restoration of mined-out bauxite lands in Jamaica." This project was previously sponsored by the Jamaican Agricultural Development Foundation Research Program. Dr Wellington and Sylvan McDaniels of ALCAN's Agricultural Division expressed interest in working with specialists of SCS to reduce soil erosion and improve the sustainability of agriculture on restored mined-out bauxite lands.

The people of ALCAN were exceedingly helpful and interested in the project. They assisted with all logistical arrangements, communicated with both customs and shipping agents, arranged for survey crews and backhoe operators, and were involve in the field work.

8. Results:

1. Data collected in this survey will be used to support an on-going research project.

The performance of ground-penetrating radar (GPR) was most exceptional. This study represented my first opportunity to use GPR on highly-weathered tropical soils. In the profiled fine-textured tropical soils, observation depths were greater than 3 meters (even with the 500 mHz antenna). Generally, in nontropical areas, profiling depths in fine-textured soils are less than 0.5 to 1.0 meters. This study confirms feelings that GPR technology is well suited to use in highly weathered tropical soils having low electrical conductivities.

2. In areas of restored soils, radar profiles were often difficult to interpret because of intricate and discontinuous subsurface layers and numerous rock fragments. These features produced complicated radar profiles and, in some areas, masked the soil/bedrock interface. In the absence of sufficient ground-truth observations, the identities of many layers were unknown.

3. At the selected sites, depths to bedrock could not be predicted from landscape position alone. However, across most sites general trends could be predicted. At Russell Place, a lower-lying foot slopes site had deeper depths to bedrock than a higher-lying side slopes site. At the Trinity Site, two side-slope sites had similar depths to bedrock.

4. The use of the EM38 meter to assess the depth to bedrock in areas of restored mined-out bauxite lands appears to be inappropriate. At each site, no to very weak relationships

(r^2 ranged from 0.002 to 0.335) were found between EM response and the depth to bedrock or elevation. The EM31 meter may be a more appropriate tool.

At the four sites, values of apparent conductivity were exceedingly low and no marked conductivity contrasts (either vertical or lateral) were observed. At 83 percent of the observation points (385), values of apparent conductivity were greater in measurements taken in the horizontal dipole orientation (0 to 0.75 m) than in vertical dipole orientation (0 to 1.5 m). This pattern of decreasing apparent conductivity values with depth conforms with the anticipated soil conductivity model. This model hypothesized that more conductive materials (restored soil materials) would occur near the surface and more resistive materials would occur with increasing soil depths (limestone bedrock). However, the apparent contrast between these two materials was less than anticipated. In terms of apparent conductivity, the electrical properties of restored soil materials and the limestone bedrock were closely similar.

5. Electromagnetic techniques produce qualitative results. Results depend on the adequacy of interpretations. Interpretations are based on available information concerning the nature and complexity of soil, geologic, and terrain conditions at a site, and the number and type of observations used to support or verify the inferences drawn from EM survey.

With kind regards,

James A. Doolittle
Soil Specialist